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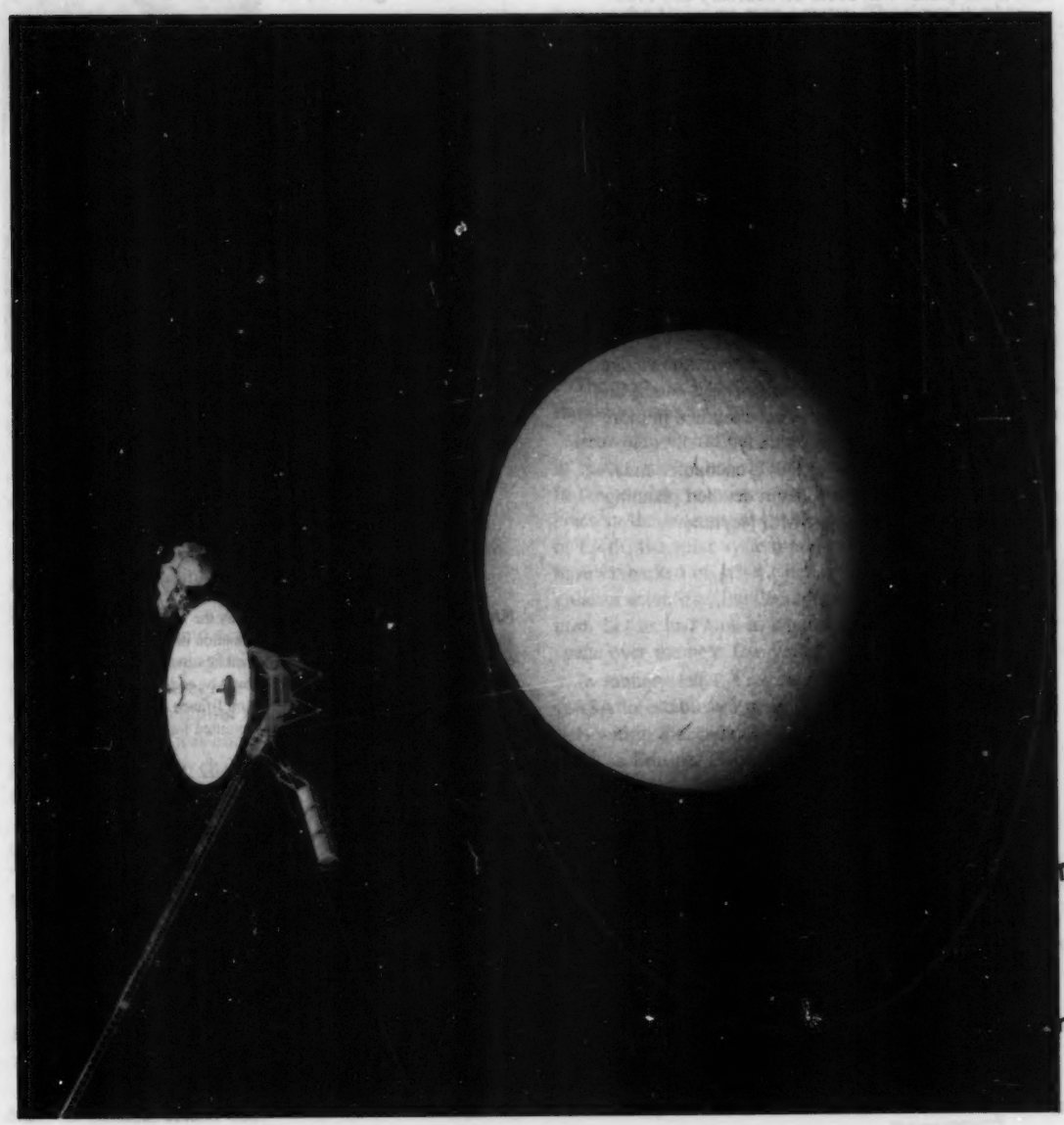

About The Cover

This painting shows NASA's Voyager 2 as it will appear when it encounters Uranus on Jan. 24, 1986.

Launched in September 1977 and having completed highly successful investigations of Jupiter in 1979 and Saturn in 1981, Voyager 2 will encounter Uranus at 10 a.m. (PST), passing within 64,500 miles of the planet's cloud tops.

The encounter will be the most intensive study of Uranus ever undertaken, with initial observations beginning November 4, 1985. The spacecraft's last look at the planet will occur on February 25, 1986.

Voyager 2 along with its predecessor Voyager 1 are the most sophisticated robotic spacecraft ever flown. Unlike earlier spacecraft, the Voyager spacecrafts are programmed to make independent decisions that safeguard both the spacecraft and its ability to communicate with Earth.

Voyager 2 carries instruments to conduct 11 experiments. Among them are television cameras, infrared and ultraviolet detectors, and a communications system that doubles as a radio experiment. Three sets of twin computers control the spacecraft's stability in space and govern both prescribed and autonomous actions.

In half a day, scientists will gain more knowledge of the planet and its moons, strange ring systems and unique magnetic field than has been learned in more than 200 years of astronomical study.

Almost as soon as the Voyager 2 encounter ends, scientists and engineers will begin detailed planning of Voyager's 1989 encounter with Neptune.

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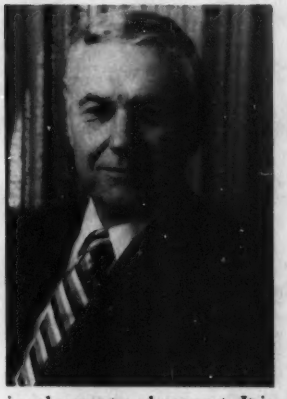
Administrator's Column

(In this column, NASA Activities features excerpts of an article by NASA Administrator James Beggs. These articles focus on subjects chosen by him that address topics of broad interest to the agency's employees. The column this month features an address presented at the United States Space Foundation Second Annual Symposium, Colorado Springs, Colorado.)



Exploring And Working In Space

Our young people will determine America's future in space. They will be the scientists, the engineers and the taxpayers who will secure that future through their interest, involvement and support. It is vital then, that we continue to help them adapt to the Space Age and the technological revolution it has helped to spawn.

We must continue to motivate them to aspire to excellence to go as high as their ambition and courage will take them. And if we can persevere in feeding their insatiable hunger for knowledge, stimulating their imaginations and expanding their horizons, we will have given them, and our country, a priceless gift indeed.

Space has come into our lives to stay. It drives our scientific and technological progress. It is playing an increasingly important role in contributing to our economic, social, cultural and even physical well-being. And, because it is endless and holds great mysteries, it continues to challenge the human species to dare to explore and understand it.

How we meet that challenge through the end of the century and beyond will, in Shakespeare's words, "fill up chronicles in time to come," and indeed, I believe, could affect the course of civilization itself.

At NASA, we have always liked to look ahead. And because we do, some of our great dreams have become realities. So tonight, I would like to do that. I will take my cue from the authors Will and Ariel Durant. You may remember that after completing their many-volumed history of the world, they sat down and wrote one last book called "The Lessons of History."

In that book, they concluded, among other things, that human nature has not changed since the days of the Caesars; progress is always slow and Utopia is not in sight. But, in spite of all that, the Durants believed that the course of civilization has been gradually upward.

I agree with that, I also believe that since the dawn of the Space Age, we have been on a voyage of discovery that has moved civilization upward farther and faster than in any other period in history.

The distances in the solar system are very great, those in the Universe even greater. The times it takes for our spacecraft to cover them are very long. Yet, by the end of this decade, we will have taken a close look at all of the planets in our solar system, except Pluto, the farthest from our sun. And with the Hubble Space Telescope, we will, incredibly, have seen galaxies some 14 billion light years away, seen them as they were when the light we see left them 14 billion years ago.

Since our best estimate of the age of the Universe is some 14 to 15 billion years, we should be able to see back in time almost to its beginnings. We will, in effect be experiencing the present existence of the past.

The poet Browning wrote, "Ah, but a man's reach should exceed his grasp, or what's a heaven for."

Browning would be delighted at what we are doing in space. For we are, literally, reaching for the stars. In the coming years we will continue to reassess our place in the cosmos and increase our understanding of Earth, the solar system and the Universe. We have embarked on what I believe to be humanity's greatest scientific, intellectural and cultural adventure. Let us just look at what we will be doing in space over the next few years.

In January 1984, President Reagan called on NASA to establish a permanent, manned Space Station within a decade. He also invited our friends and allies in Europe, Canada and Japan to join with us in building, operating and using the station through the end of the century and beyond. We are very pleased that they have decided to work with us in the initial design and definition phase.

The Space Station, will be the key to all our future efforts in space. From there, we could go back to the Moon, build a base and begin to mine its resources.

Using the station as a staging base, we could also send people to explore Mars, next to Earth, the most hospitable of planets to humankind. We could begin visits to the asteroids, deep space probes, and other

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endeavors we can hardly imagine today. The Space Station will open options as boundless as space itself.

But before those activities begin, we will be doing other things on the Space Station. Among the most important will be industrial research for extended periods of time, just like we do on Earth—research which will benefit all mankind. The microgravity of space will enable us to manufacture new medicines and vaccines, new alloys and perfect crystals, materials difficult or impossible to make on Earth.

The near-perfect vacuum that will exist in the wake of the station will be a boon to industry. Reproducing such a vacuum on Earth is very expensive, and the vacuum is short-lived. Once we are on the Space Station, we will get it free and for as long a period as necessary.

On the Space Station we will be able to use the magnificent vantage point of space to study Earth and the Universe for periods of long duration. We will get a continuous view of Earth, the solar system and the Universe, unobstructed by Earth's atmosphere. So, for the first time, we will be able to observe nature at work on Earth and in space, continuously, for decades at a time.

Most satellites are relatively short-lived. The Space Station will help to prolong their life, because from there, we can reach them and bring them in for service and repair. Our dramatic satellite repair and rescue missions this year and last are just a preview of the kinds of things we will be doing once the station is up and operating.

The station will have both manned and unmanned elements. We expect it to grow and evolve as our needs in space expand, and, with the full participation of our friends and allies, we expect that the station's capabilities will expand manyfold as we continue to explore commercial, scientific and industrial opportunities together.

But even before the Space Station opens for business, we and our international partners will be doing some very exciting and challenging things in space.

Next year, for example, will be one of the most important years ever in the history of space exploration.

In January, our Voyager 2 spacecraft, launched in 1977 to study the outer planets, will fly by Uranus. We will get our first close look at that seventh planet from the sun, which is almost invisible from Earth without the aid of a telescope. We expect to learn much about it and its five known moons and to see things we have never seen before.

Also in January, we will launch a spacecraft called Spartan from the Space Shuttle. Spartan will give us the first look at the tail of Halley's Comet in the ultraviolet portion of the spectrum. It will be a very useful complement to the international effort in March to study the comet intensively for the first time from spacecraft.

One of our contributions to that effort, and an important one, will be to observe and photograph the comet from the Space Shuttle with special instruments and a unique wide-field camera. In March, we will launch a shuttle payload called ASTRO, which will be brimful of scientific instruments to study Halley's Comet in the far ultraviolet part of the spectrum. The camera on ASTRO will photograph the comet in its entirety. We regret we will not be sending a probe to Halley's. But we expect ASTRO to provide a superb set of images and the most complete sampling of a comet's ion and dust tail ever made.

In May, we will launch two great probes, both the fruits of international efforts, one to the sun and one to Jupiter.

The first will be the Ulysses spacecraft which will study the sun's poles for the first time.

The Ulysses project was developed by the Europeans and has some American instruments on it. Now, you may think we're a bit daft to launch Ulysses towards Jupiter, when that planet is 391 million miles farther from the sun than we are. But that's what we will be doing, so as to take advantage of Jupiter's gravity and use it to sling-shot Ulysses over the sun's poles.

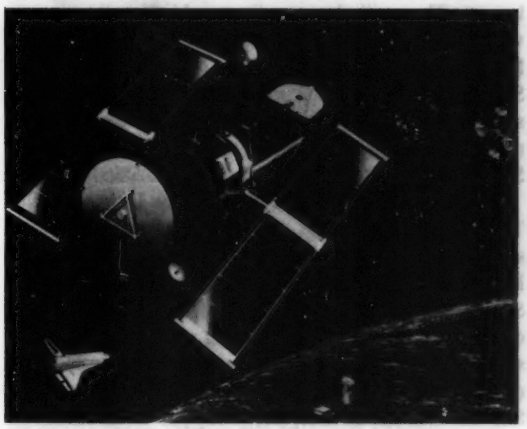
We'll be going directly to Jupiter, though, with Project Galileo, the second great probe, which is named after the great Italian astronomer who discovered the four largest Jovian moons 375 years ago. Galileo will make the first comprehensive survey of the Jovian system, the planet and its satellites. That system has been likened to a miniature version of our own solar system.

Galileo will send a probe vehicle to penetrate deep into the maelstrom of Jupiter's atmosphere. It also will put an orbiter around the planet for many months to traverse its complex magnetosphere, observe its changing cloud patterns and atmospheric structure and study its major satellites. So, for the first time, we will be able to sample the primordial gases from which we believe our own Earth evolved.

In August, we will launch the Hubble Space Telescope, which, as I have already explained, will open wide our window on the Universe.

The Space Telescope is probably the most important scientific instrument ever to be put in space. With it we will be able to see objects 7 times farther,

50 times fainter and with 10 times the clarity than we can now with telescopes on Earth. Let me give you an idea of how the Space Telescope will extend our vision. If you were to lie on your back in an average-sized room with a normal 8-foot ceiling and obscure your view with your hand about 8 inches from your eye, that would equate to what we can see now with Earth-based telescopes. Then put your hand down. Your new field would represent the Space Telescope's expected field of vision.



Artist concept of the Space Telescope showing the Shuttle, TDRSS, and a ground station.

The Space Telescope's scientific contributions may dwarf all but the most fundamental discoveries of the past, and lead to a quantum growth in our understanding of the basic nature of time, matter and energy and their interrelationships. In short, the Space Telescope may help us prove what Einstein never could: that there is a single all-embracing theory—a unified field theory—that ties all the physical laws together.

Then, in December, as Galileo proceeds towards Jupiter, it will fly by and view at close range a very large asteroid called Amphitrite. For the first time, we will get good measurements of a large object in the asteroid belt. We may learn its exact composition and perhaps increase our understanding of how the asteroid belt came into being.

So next year will be a splendid year for science in space and I hope you will all follow what we will be doing. But, as you do, remember that we will be just beginning. The Hubble Space Telescope will be only the first of our permanent facilities in space. By the mid-1990s, we expect to be launching larger arrays of instruments. We'll bring on an x-ray observatory, a more up-to-date infrared observatory and many, many others as the years roll by. All of them will live for a very long time and return many times our investment in new knowledge and in new technology which will benefit us right here on Earth.

I believe we are at a key turning point in our enterprise in space. We are entering an era where new tools like the Space Station, the Space Telescope and advanced technologies and concepts will extend both our vision and our reach.

Shakespeare wrote: "Nature must obey necessity."

Our nature is to want to know. That is our cultural imperative, and, indeed, our cultural inheritance.

Since the dawn of civilization, people have gazed at the heavens and speculated about our place in the Universe. Their thoughts are enmeshed in all religions and all cultures. We are, at long last, beginning to unravel the mystery of who we are and how we came to be. We are beginning to put together the pieces of the complex chain that connects the first instants of the Universe with its evolution and its destiny.

The happy consequence of that effort is that it benefits all of us on Earth.

So I would say again that the Durants were right on. The trend of civilization has been upward. So it will continue as long as we continue to wonder and as long as we continue to want to know.

And, if the past 27 years of exploring and working in space is any guide, I believe that will be for a very long time, indeed.

Student Project To Fly On Astro-Halley Mission

The National Aeronautics and Space Administration has announced that an educational experimental package has been added to the Astro-1 payload, scheduled for launch aboard the Space Shuttle Orbiter Columbia on March 6, 1986.

The "Can Do" student experiment, sponsored by the Charleston County, S.C. school district, will be included in the Astro-1 payload package that will perform a wide variety of astronomical observations. The Astro-1 complement of three ultraviolet astronomical instruments and a special visible-light, wide-field camera system will study Halley's Comet and other celestial objects during its 9-day flight in space.

The primary objective of the student project is to photograph Halley's Comet. Middle school students, grades 6 through 8, will study and interpret astronomical photographs obtained from the flight.

The photographic equipment, four 35mm still cameras equipped with lenses addressing a particular aspect of cometary science, will be contained in a canister normally used for Getaway Special experiments. In addition to the comet photography experiment, the canister will contain a separate package of passive student experiments including biological samples, magnets and two kinds of accelerometers to study the effects of microgravity.

The camera package, developed with the participation of the National Geographic Society, Washington, D.C., will use a newly-developed color film with unprecedented film speeds to photograph the dim tail of Halley's Comet. The color pictures will complement the black-and-white images obtained by Astro-1's own image-intensified, scientific wide-field camera.

The Can Do project received active support from NASA's Langley Research Center, Hampton, Va.; Goddard Space Flight Center, Greenbelt, Md.; and Marshall Space Flight Center, Huntsville, Ala. The project also was assisted by the National Geographic Society, Washington, D.C.; the College of Charleston, S.C.; the Medical University of South Carolina; the West Ashley Optimist Club; and other organizations in the Charleston area. Several national manufacturers also supplied support for the project.

The Can Do project coordinator is Charles A. Traynor of the Charleston County school system.

Live Lessons To Be Broadcast To Classrooms During Shuttle Mission

A network of satellites will allow Teacher in Space, Christa McAuliffe, to teach millions of students two lessons live from space during Space Shuttle mission 51-L in January 1986.

Television viewers may access these historic live lessons in two ways. Local Public Broadcasting System (PBS) or cable stations will carry the programs via PBS uplinks and downlinks to Westar IV and satellite dish antennas may receive the programs directly from the communication satellite.

NASA and PBS reached an agreement for PBS to carry the live lessons via Westar IV. PBS will be offering the programs to member stations which will be requested to preempt regular instructional television or classroom programming on those days to carry the lessons live. Westar IV will downlink the lessons from Satcom F-2R, Transponder 13, which carries NASA-Select programming.

Specific information about the PBS transmission may be obtained by writing to Elementary and Secondary Programs, Public Broadcast Services, 475 L'Enfant Plaza, S.W., Washington, D.C. 20024 or by calling 202/944-3684.

Classroom Earth, a Spring Valley, Ill. organization, dedicated to direct satellite transmission to elementary and secondary schools, will serve as the center for information and materials for schools that wish to use their own satellite dish antennas to receive the live lessons. They will also coordinate a Mission Watch, which will cover aspects of the entire mission. Barbara Morgan, backup candidate for the NASA Teacher in Space Project, will act as moderator for the broadcast to schools. Specific information about the satellite transmission is available by writing to Classroom Earth, Spring Valley, Ill. 61362 or by calling 815/664-4500.

McAuliffe will teach a lesson on "The Ultimate Field Trip" on Flight Day 4 of the mission currently scheduled for launch no earlier than Jan. 22, 1986. This lesson will allow students to compare daily life on the Shuttle with that on Earth. McAuliffe will take viewers on a tour of the Shuttle, explaining crewmembers' roles, showing the location of computers and controls and explaining experiments being conducted on the mission. She also will demonstrate how daily life in space is different from that on Earth in the preparation of food, movement, exercise, personal hygiene, sleep and the use of leisure time.

The second lesson, "Where We've Been, Where We're Going, Why?" on Flight Day 6 of the mission will help the audience understand why people use and explore space by demonstrating the advantages of manufacturing in the micro-gravity environment, highlighting technological advances that evolve from the space program and projecting the future of humans in space.

Both half-hour programs will begin at approximately 1:00 p.m. EST. NASA will update stations and viewers on precise dates and times immediately after launch.

At present, NASA is preparing a Teacher's Guide for use by instructors of students, K-12. These guides will be distributed without charge through PBS stations, Classroom Earth, professional educational organizations, and NASA. Full distribution details will be announced later.

From The Director Of GISS

(James Hansen, head of the Goddard Institute for Space Studies in New York City, describes the objectives and research programs at this NASA laboratory.)

The Goddard Institute for Space Studies (GISS) was established in May 1961 as a New York office of the Goddard Space Flight Center (GSFC). The GISS mission is to conduct basic research in space and Earth sciences in support of present and future Goddard programs by working cooperatively with New York area universities and research organizations, especially Columbia University, on whose campus GISS is housed.

GISS is a division in Goddard's Space and Earth Sciences Directorate, which conducts a large part of NASA's terrestrial and astrophysical observations. The principal GISS role within the organization is to help define Goddard's research program in the area of global change/global habitability, working with the laboratories for atmospheric, oceanic and terrestrial physics.

Global change or global habitability is an interdisciplinary research initiative addressing changes in our environment, either of natural or human origin, which occur on decadal time scales and affect the habitability of our planet. The concept for such a research program was initiated at a NASA workshop in 1982 and subsequently has gathered support from other agencies and international organizations. The program necessarily will involve global satellite observations, as well as in situ measurements, laboratory work and modeling. GISS modeling studies and interdisciplinary activity with Columbia University departments and with Goddard laboratories in Greenbelt, Md. are aimed at helping to define the contributions which Goddard can make to this program.

GISS has a staff of about 20 civil servants supported by an on-site contractor staff of about 55 persons. Cooperative agreements with several Columbia University departments are an essential part of the GISS program, providing a mechanism by which about 40 graduate and undergraduate students and 10 university research scientists work on-site on GISS research projects. National Research Council Resident Research Associates provide an additional valuable rotating pool of talent.

The GISS setting and mode of operation, with a small civil service staff, cooperative relations with a number of university departments and extensive use of post-doctoral researchers and students, allows a flexible research program which can change in response to NASA goals and which can readily address interdisciplinary problems. In the 1960's the focus of the research at GISS was on space sciences, i.e., lunar, planetary and astrophysical studies. The focus shifted in the 1970's to applications of satellite data to meteorological forecasting and Earth resources. Now the principal research areas are long-range climate, biogeochemical cycles and planetary atmospheres.

Climate research focuses on the causes of long-range (10-100 year) climate changes. This includes development of global climate models and applications of these models to studies of the climate effect of changes in such factors as atmospheric composition, volcanic aerosols, solar irradiance and surface boundary conditions. Our climate models suggest that the 'greenhouse' warming of Earth due to the growth of atmospheric trace gases will have effects by the 1990's which begin to exceed the level of natural climate variability. Satellite observations will be crucial for early detection of climate trends as well as for measurement of climate forcing factors and analysis of climate feedback mechanisms, all of which will be required for reliable prediction of larger climate effects in following decades.

One climate mechanism of special interest in our studies concerns the role of clouds in the climate system. In this regard, GISS is serving as the Global Processing Center for the International Satellite Cloud Climatology Project. The objective of this project is to obtain a 5-year record of global cloud conditions, providing a means of check cloud prediction capabilities of climate models. GISS also is investigating the interactions between stratospheric change and climate at the earth's surface.

Research on global biogeochemical cycles at GISS principally involves the study of atmospheric trace gases with a three-dimensional chemical tracer model which utilizes winds, atmospheric structure and convective transports from a general circulation model. This research is being carried out in cooperation with Harvard University and the Department of Applied Physics at Columbia. The aim is an improved understanding of the cycles of O_3, NO_x, OH and other trace gases. Many trace gases are presently observed to be increasing in the atmosphere. Development of 3-D models for global troposperic chemistry is essential for determining the sources and sinks of these gases and for predicting of future atmospheric composition. A related project concerns the role of the biosphere in the global carbon cycle, investigated from a combination of

satellite measurements related to primary productivity and a global 3-D carbon tracer model.

Planetary research at GISS has as a key objective the comparative study of radiative, dynamical and chemical processes in several atmospheres, in addition to exploring the individual planets. Our on-going Cloud Photopolarimeter experiment on the Pioneer Venus orbiting spacecraft is obtaining a climatology over nearly a decade of cloud-tracked winds, planetary-scale waves, and cloud and aerosol properties for Venus. Our Photopolarimeter Radiometer experiment will be on the Galileo spacecraft, to be launched by the Space Shuttle in 1986 and to begin orbiting Jupiter in 1988. This experiment will measure cloud and aerosol properties, the planetary radiation budget and atmospheric temperature profiles, the combination of which will yield a comprehensive study of the climate of Jupiter.

There is a natural overlap of research in the above areas. For example, the planetary studies in effect represent an ensemble of experiments which test the climatic impact of basic parameters such as solar constant, planetary rate of rotating and atmospheric composition, thus helping to provide a better understanding of basic climate mechanisms on Earth. Many of the GISS atmospheric scientists are involved in both terrestrial and planetary research. The activity of senior scientists cuts across astrophysical, planetary and terrestrial research boundaries, for example, via study of the role of solar luminosity changes in climate change and the role of turbulence in the formation of planets and the Earth's atmosphere.

A broad overall goal of the GISS program is to support the interdisciplinary concept defined by NASA and other agencies as global habitability or global change. As one specific activity, we collaborate with the Center for the Study of Global Habitability in the Provost's Office of Columbia University, together defining monthly global habitability seminars during the academic year. These seminars bring together academic scientists, agency representatives, policy makers and often, the media to discuss global change problems and the relevance of space measurements toward solutions or better understanding. We also are organizing workshops on topics believed to be relevant to global habitability, specific current examples being workshops on the subjects of North Atlantic Deep Water formation and climate/biosphere feedbacks. The objective, through both our research and these specific activities, is to help define feasible interdisciplinary approaches and space observations which will yield a better understanding of our terrestrial environment.

Inside NASA

NASA Flight Simulator Declared Operational For Commercial Aircraft Safety

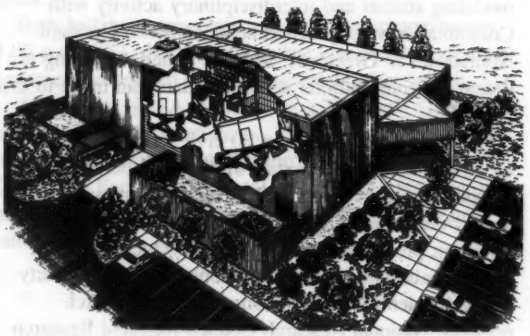
NASA scientists have a new tool to study human factors, such as pilot and crew communication, fatigue, and stress, involved in operating today's and tomorrow's commercial aircraft. This highly realistic flight simulation laboratory called the Man-Vehicle Systems Research Facility (MVSRF) is now in operation at NASA's Ames Research Center, Moffett Field, California.

MVSRF contributes to flight safety by allowing researchers to simulate, safely on the ground, the complex set of relationships among pilots, their crews, converging aircraft, the weather, and air traffic controllers. Using this facility, scientists can study human error in the operation of transport aircraft. They can also study the effects of new and increasingly automated technologies on flight crew performance.

MVSRF includes an exact replica of a Boeing 727 cockpit, a mock air traffic control station, and a futuristic cockpit known as the Advanced Concepts Flight Simulator (ACFS).

According to Dr. David Nagel, Acting Chief of the Aerospace Human Factors Research Division at Ames, "The 727 mock-up is a first rate piece of equipment. Commercial airline pilots we've run though it say it's one of the most realistic and flexible transport simulators they've ever flown."

The ACFS won't display all its capabilities until a new computer is installed, but researchers already are using it.



A cutaway drawing depicting the MVSRF housed inside the Ames building.

"NASA-Ames is one of the pioneers of full mission simulation for human factors research," Nagel says. "From filing a flight plan to landing, it's as though the pilot, crew, other pilots, and ground controllers were involved in a real flight situation."

"We may have them flying from San Jose to Denver; and create some sort of weather system that forces them to divert to Cheyenne," he says. "Then we might create an oil leak that forces them to make additional safety-of-flight decisions."

In both the 727 replica and the ACFS, a computer visual system provides out-the-cockpit window displays of approaching aircraft and the landscapes of many U.S. airports. It depicts clouds, and other weather conditions, the glow of the horizon at dusk and dawn, and the varied textures of the area illuminated by the simulated aircraft's landing lights.

Professional air traffic controllers in the MVSRF's traffic control station advise the pilots of weather conditions and the position of other aircraft along the "flight path," and cockpit instruments register as they would during an actual flight. The fuel guage, for instance, is affected by simulated wind speeds, flight directions, and throttle settings.

Researchers in the MVSRF experimenter station monitor communications among flight crew members and between the crew and traffic controllers. They read the aircraft instruments and observe flight control settings. "We can measure the position of the controls at all times, and know exactly when a flight event occurs," Nagel says. The experimenters make audio and video recordings, and can even track a pilot's eye movements.

NASA's human factors researchers work directly with the FAA, airplane manufacturers, and commercial airlines to improve flight safety. With the 727 simulator, NASA scientists have researched airplane landings to learn methods of approach that minimize fuel consumption while allowing pilots to maintain safe distance between their plane and other air traffic. In participation with airline industry researchers, they have developed a simulator program that helps airlines train pilots to fly safely during wind shear conditions—abrupt changes in wind speed and/or direction that can occur during thunderstorms. And in an on-going pilot assessment study, they are evaluating measures of pilot performance.

FROM THE CONGRESSIONAL RECORD

Senator Sam Nunn introduced a joint resolution designating the week of January 13 through 19, 1986, as "National Productivity Improvement Week" to the Committee on the Judiciary and provided the following remarks:

For several years it has been my pleasure to introduce a Senate joint resolution designating a week as "National Productivity Improvement Week." I am once again pleased to offer the joint resolution designating January 13 through 19, 1986, as "National Productivity Improvement Week."

American productivity brought this Nation to the economic leadership of the world. While America still leads in productivity, other nations are closing the gap. Since the seventies, the rate of productivity improvement of other countries — especially Japan — has exceeded that of the United States. Many economists predict that the United States will enventually lose its productivity leadership unless improvements are made in U.S. productivity. Therefore, it is very important that we continue efforts to promote productivity improvement and awareness.

When productivity here isn't doing as well as abroad, then the United States faces a major problem: An imbalance of trade. Now well in excess of $100 billion, the U.S. trade deficit looms as a threat to the standard of living in this country. As Dr. Allen S. Puckett, head of Hughes Aircraft Corp., so succinctly put it: "We can't continue to buy products we didn't make with dollars we didn't earn."

Just as ominous as the trade deficit is the threat of high inflation — and here again we can focus on productivity as a deciding force. Why is this so? Because inflation has a snowball effect. Our economy has become accustomed to at least some inflation and by now paychecks often are arbitrarily increased from time to time based solely on the so-called cost-of-living index. Remember, whenever a company incurs this kind of expense without a corresponding increase in productivity, it has to be made up somewhere. And of course you know where it's made up — with higher price tags on the goods and services offered.

Then we're off on another round of the dangerous inflation cycle. Obviously, this danger dovetails right

into the trade deficit problem when higher prices of U.S. goods make less expensive foreign-produced goods more attractive to the American consumer.

Besides price considerations, of course, is the comparison of quality. Quality should be an integral part of any productivity program. The two together add up to the excellence which brought our nation to the forefront in world economy in the first place.

Industrial engineers and others working with these professionals are spreading the word about the importance of productivity improvement. They're encouraging organizations of all sizes to take immediate steps to set up meaningful productivity programs.

In business, in industry and in government management can help by carefully reviewing their organization's method of doing business. For example, workflow needs study to determine what wasted time or materials can be eliminated. Just as importantly, management needs to review its workforce relationships. Employees are motivated by being made part of the productivity planning team, yet many organizations fail to take advantage of this fact.

Those anywhere on the labor ladder must do their part to foster a strong team effort on the job. An attitude of cooperation in itself goes a long way toward productivity improvement. This has been proved time and again — a company with positive attitudes of management and labor working together almost always becomes a creative and successful entry into the marketplace.

For several years, it has been my pleasure to introduce this joint resolution on behalf of the Institute of Industrial Engineers. The American Institute of Industrial Engineers has been very successful in their public information campaign in promoting a better understanding of the critical aspects of productivity improvement. Throughout the month of January, the Institute will conduct its seventh annual productivity awareness campaign as a public information service. "Productivity Plus Quality Equals Excellence" is the theme for the 1986 campaign.

I hope that my Senate colleagues will join me in cosponsoring this joint resolution designating January 13 through 19, 1986 as "National Productivity Improvement Week." I urge the Senate to act expeditiously on this joint resolution.

(Mr. Nunn introduced this joint resolution for himself and Mr. Mattingly, Mr. Goldwater, Mr. Chiles, Mr. Hollings, Mr. Stennis, Mr. Pryor, Mr. Bentsen, Mr. Boren, Mr. Heflin, Mr. Zorinsky, Mr. Laxalt, Mr. Durenberger, Mr. Chafee, Mr. Inouye, Mr. Helms, Mr. Bumpers, Mr. Boschwitz, Mr. Hatfield, Mr. Dixon, and Mr. Levin)

Heard From Around The World

. . . (from non-NASA sources)

France—The French National Center for Space Studies recently announced that Aerospactiale and Dassault-Breguet Aviation Co. would build the European space shuttle Hermes. Two models will be built during the next several years under the center's auspices, probably with sponsorship by ESA. Aerospactiale will lead the project, while Dassault will handle the aeronautical aspects. Hermes will be designed to carry two astronauts and a payload of 4.5 tons into low-Earth orbits.

Israel—The Israeli Space Agency has inaugurated a new satellite observatory in the Judaean Hill in cooperation with NASA. As one of 30 facilities around the world, the observatory will bounce laser beams off a satellite 6,000 miles in space to measure movements in the Earth's crust.

West Germany—Martin Gruener, secretary of state in West German's Ministry of Economics, recently voiced his support for the commercialization of space. "There is a growing international competition in a worldwide marketplace," he said, and "we must not fear the fresh wind of international competition . . . we are well prepared." The financial burden of space technology has to pay off and markets have to be developed. In areas such as pharmacy, life sciences, electronics and materials processing, "the European space industry has reached a top position," he said.

India—India has named two astronauts to be trained to fly onboard the U.S. Space Shuttle next year as payload specialists. Either Nagapati C. Bhat or A. Radhakrishnan will be selected to conduct 8 to 10 experiments during the flight, including work to map the geophysical features of the Indian subcontinent through remote sensing techniques. One other Indian flew in space in April 1984 aboard a Soviet spaceship.

China—A senior Chinese expert reported the launching and recovery of China's 17th satellite, which completed 80 revolutions of the Earth to survey land resources in the interest of mineral exploitation, forestry development, village and town planning and environmental protection.

Contractor News

Boeing Computer Support Services Inc. signed a $214 million contract with NASA to design, install and operate a nationwide telecommunications network. Boeing will be the prime contractor with three major subcontractors—RCA, BAMSI, and Teledyne Brown Engineering and another 70 suppliers also will work on the project.

The network will connect 14 NASA facilities in the U.S., with the majority of work concentrated at Marshall Space Flight Center, Huntsville, Ala. Voice, data, facsimile and full motion video teleconferencing services will be integrated into one common telecommunications network.

Boeing Military Airplane Co., under a 26-month contract from NASA's Langley Research Center valued at about $1 million, will carry out analysis and detailed design of an integrated digital flight control system for high performance aircraft which would have a significant coupling between engine and airframe.

BMAC, which identified major characteristics for an integrated airframe/propulsion control system under a previous NASA contract, will select computers, sensors, actuators, signal interconnects and power bus arrangements for a flight control system applicable to 1990s aircraft.

Detailed specifications for the system, which will be designed for future growth capability, will be provided for both hardware and software so it can be fabricated at BMAC and tested in Langley's Avionics Integration Research Laboratory under a future contract. BMAC will also specify techniques for evaluating system reliability and performance, and will develop architecture validation methods.

Charles Stark Draper Laboratory, as subcontractors to BMAC, will provide information on the advanced information processing system architecture it developed for NASA, which will be applied to the BMAC-developed flight control system.

NASA's Lewis Research Center awarded a $6.7-million contract to **Teledyne Industries, Inc., Teledyne Systems Co.,** Northridge, Calif., in support of the Shuttle/Centaur program.

The sole-source, cost-plus-award-fee contract covers management and engineering, repair services and hardware support for digital computers and remote multiplexer units for Centaur launch vehicles.

Work under this contract will be performed at the contractor's plant in Northridge. The 2-year contract was effective Nov. 1, 1985.

The digital computers act as the focal point for the Centaur flight control system, processing data from the other flight subsystems, including the multiplexer units. The computers also provide the hardware capability to interface with the Shuttle orbiter and the ground system.

The first Centaur launch from the Space Shuttle cargo bay, the Ulysses mission, is scheduled for May 15, 1986. It will be followed by the Galileo mission launch on May 21, 1986.

NASA's Ames Research Center, Mountain View, Calif., awarded **Zero One Systems, Inc.** (formerly Technology Development of California), Santa Clara, Calif., a system capability service contract.

The estimated value of the 5-year contract, which begins Jan. 15, 1986, is approximately $43 million.

Zero One Systems will provide the computational resources for research in large-scale computational fluid dynamics, aerodynamics design and analysis, computational chemistry, astrophysics, atmospheric modeling and satellite image processing at the Ames Central Computer Facility.

The contractor will deliver a total system capability, including the computational equipment, operational support and systems engineering.

The contract is a follow-on to existing services presently being performed at the Ames Research Center.

NASA has selected the **American Institute of Aeronautics and Astronautics,** New York City, for award of a contract for the acquisition, cataloging, abstracting, indexing, marketing and distribution of published aerospace literature in support of NASA's Scientific and Technical Information Program.

The cost, no-fee contract covers a period of 3 years beginning in October 1985. The $10,731,066 contract includes $9,519,616 maximum government obligation and $1,211,450 income from publication subscribers.

The work will be performed at the contractor's New York facility.

NASA's Marshall Space Flight Center, Huntsville, Ala., awarded a 33-month, $98,105,079 contract extension to the **McDonnell Douglas Technical Services Co., Spacelab Integration Division,** Huntsville, Ala., for continuing integration work.

Under the contract, the company will provide system integration, selected flight hardware, software, ground support equipment and mission integration support for manifested Spacelab missions.

The extension, which runs from Oct. 1, 1985 through June 30, 1988, brings the total value of the contract to $341,496,165.

The Marshall Center is responsible for mission integration and sustaining engineering for the reusable international research laboratory. When carried in the

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cargo bay of the Space Shuttle orbiter, it converts the Shuttle into an Earth-orbiting, scientific research center.

The laboratory was developed for NASA under an international agreement with the European Space Agency. The Marshall center was responsible for monitoring design and development activities and for management of U.S. activities including development of selected Spacelab components.

NASA Records Management Conference

The NASA Records Management Conference was held at Headquarters October 28 through November 1, 1985. The conference provided the NASA Installation Records Management Officers who attended, an opportunity to become acquainted with the individuals and facilities connected with federal records management, to gain wider view of their roles in the national picture, to learn from each other, and to focus on improvements needed in agency procedures for a more effective NASA Records Management Program.

The conference was planned, coordinated and conducted by Nina K. Letaw, NASA Records Officer, Records Management Branch, Logistics Management and Information Programs Division. There were 14 speakers from outside NASA and 23 NASA speakers covering the diversity of interactions that were required to conduct the program. Some of the action items were:

Publish an NMI covering electronic recordkeeping;
Publish the updated NASA Correspondence Handbook;
Address the problem of the generation of unauthorized forms;
Identify photographs better;
Automate the directives system;
Encourage centers to automate the inventory of records stored on-site and at federal records centers, if not already doing so;
Cover contingency planning for the recovery of magnetic media in records management directives;
Monitor the adoption of the NASA Uniform Files Index;
Revise the NASA records holdings report.

Attendees of the conference were: (Seated, left to right) Glenda Lancon, Johnson Space Center; Mary Fouraker, Kennedy Space Center; Nina K. Letaw, NASA Records Officer; Jane Carpino, Goddard Space Flight Center; Judy Wheeler, National Space Technology Laboratories. (Standing, left to right) Ray Launer, Jet Propulsion Laboratory; Doris Grosshauser, Johnson Space Center; Evelyn Carnahan, Lewis Research Center; Barbara Newton, Langley Research Center; Glyndon Loftis, Marshall Space Flight Center; Catherine Garcia, Ames Research Center; Nancy Fricker, Dryden Flight Research Facility; Adria Lipka, NASA Records Management; William Cooper, Goddard Space Flight Center; William Simkins, Langley Research Center; Sharron Sample, NASA Headquarters; Carl F. Steinmetz, Chief, Records Management Branch.

From The Office Of Procurement

Recent Procurement Developments

. . . Stu Evans

Procurement personnel at NASA are charged with overseeing the expenditure of funds through the procurement process in accordance with applicable statutes and regulations, and we are proud of our record. For example, we were pioneers in the development of source evaluation board procedures for major procurements, and these procedures became models for other federal agencies. In virtually all protests to the Comptroller General involving NASA procurements, the Comptroller General has ruled in favor of NASA. Our stewardship role traditionally has included encouraging competition in procurement to the maximum extent feasible, and NASA has maintained an excellent record in this area both in terms of the number of contracts and the dollars awarded competitively each fiscal year. NASA was among the leaders in the development of procurement data systems which tracked statistics on competition.

In recent years, both the Administration and Congress have become increasingly interested and involved in the procurement process.

Executive Order 12352 on Federal Procurement Reforms emphasized the importance of competition in procurement and the implementing guidance issued by the Office of Management and Budget (OMB) recommended the establishing of competition advocates in all federal agencies. On April 12, 1984, NASA Management Instruction (NMI) 1210.2 was issued to establish the Competition Advocacy Program. On July 18, 1984, Public Law 98-369, the Competition in Contracting Act (CICA) was enacted. CICA legislated extensive changes in the federal procurement process, especially in the area of competition enhancement. To conform the NASA Competition Advocacy Program with the competition enhancement requirements of CICA, NMI 1210.2 was issued on April 16, 1985.

Since many of the key decisions impacting competition are made by requirements personnel, rather than by procurement personnel, the NASA Competition Advocacy Program focuses responsibility on key program managers. The agency competition advocate is the Chief Engineer, Dr. Milton Silveira. As part of his organization, Dr. Silveira has established a Competition Advocacy Office headed by David J. Austin. Dr. Silveira and I coordinate extensively on competition issues and my staff provide assistance to Austin in the daily functioning of the competition advocacy office. The center competition advocates are the Deputy Center Directors. Placing key competition advocacy responsibility at this high level should help to assure a successful competition advocacy program at NASA.

The NMI lists 10 duties of the competition advocates, while noting that that list is not all inclusive. Those duties are: fostering long-term procurement planning and consideration of competition enhancement at the requirements determination stage; considering component breakout where applicable for follow-on procurement; reviewing specifications or scopes of work to eliminate undue restrictiveness or ambiguities; conducting market research; encouraging the use of informational or planning purpose solicitations as appropriate; conducting site visits for major on-site support service contracts; reviewing justifications for other than full and open competition; analyzing competitively solicited procurements when only one proposal is submitted in response to the solicitation; providing training on competition enhancement to procurement personnel and requirements personnel; and identifying actions taken to increase competition at NASA and remaining barriers to full and open competition.

Under the NASA Competition Advocacy Program, each center develops annual competition advocacy plans that include specific activities proposed for that fiscal year to enhance competition. At the end of each fiscal year, center competition advocates prepare annual center competition advocacy reports, which measure progress in terms of accomplishment of the items specified in the center competition advocacy plan for that year as well as any other strides made during that fiscal year to improve the competitive posture of the center. Both the plans and the annual reports are submitted to the Chief Engineer on the 16th day of the fiscal year.

Within 90 days after the competition of each fiscal year, the Chief Engineer submits to the Administrator an agency competition advocacy annual report. That report includes: actions taken to achieve full and open competition during the preceding fiscal year, remaining barriers to full and open competition; new initiatives to increase competition, and recommended NASA competition goals for the fiscal year in progress. Goals are based on total procurement dollars and total procurement actions with the dollar based on obligations and

new work modifications to existing contracts classified as new actions for goaling purposes.

This report forms the basis for the Administrator's annual report to Congress on competition, which is required by CICA for each fiscal year from 1986 through 1990. In addition to these annual reports, the Chief Engineer submits a onetime report to the Assistant Administrator for Procurement summarizing the status of competition in procurement at NASA at the outset of the competition advocacy program.

In conjunction with the oversight responsibilities of the Chief Engineer for the NASA Competition Advocacy Program, personnel from the Competition Advocacy Office will conduct annual visits to each center to review the center competition advocacy programs. To date, in fiscal year 1986, four centers have been visited and plans are being made to complete visits to the remaining centers by early October 1986.

As an example of competition advocacy activity at the installation level, I will discuss the activities of Admiral L. E. Hopkins, Deputy Assistant Administrator for Procurement, who is the Headquarters Competition Advocate. The thrust of activity in competition activity at Headquarters for fiscal year 1985 was management awareness. Admiral Hopkins conducted meetings with senior managers for the key headquarters program and staff offices. The focus of those meetings was to familiarize those managers with the NASA Competition Advocacy Program and the requirements of CICA. The meetings also served as a means to gather data on the status of competition at Headquarters and for the purpose of developing competition advocacy plans for fiscal years 1985 and 1986. These plans emphasize: training of requirements personnel in competition enhancement; establishing competition advocacy liaisons and technical monitors in the key program and staff offices; the use of sources-sought synopses as a market survey technique for requirements that are planned to be procured on a basis of other than full and open competition; and the early involvement of procurement personnel in the requirements determination process.

Another area traditionally within the area of oversight of procurement personnel is procurement system certification. NASA has long used procurement management surveys as a means to review the procurement activities of each center to assure that they are accomplishing their mission in accordance with applicable statutes, regulations and sound business judgement. Procurement management survey teams review each center approximately on a 20 month cycle, and plans are developed to monitor center actions to implement survey recommendations for improvement in the system.

Did You Know?

Astronaut Sally Ride received the Circumnavigators Club award, the Order of Magellan, in New York City. The first American woman astronaut in space, Ride is only the 17th person to receive the award. It is presented to individuals who are dedicated to advancing peace and understanding in all parts of the world and who have circumnavigated the globe. Others so honored have included Gen. Douglas MacArthur, former president Herbert Hoover, Neil Armstrong, Sen Barry Goldwater, Lowell Thomas and Thor Heyerdahl.

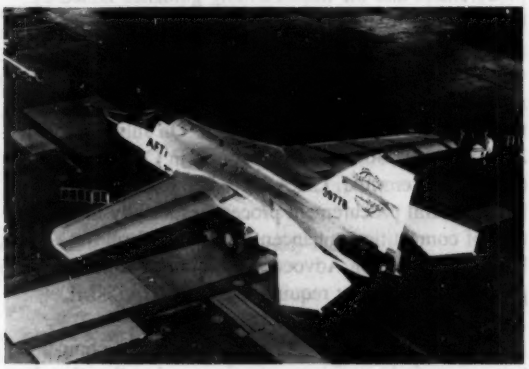
"A perfect flight!" That statement was echoed many times by AFTI F-111 Mission Adaptive Wing project personnel after the first flight of the research aircraft at NASA's Ames-Dryden Flight Research Facility.

Flying the aircraft were AFFTC's Lt. Col. Frank Birk as pilot and Ames-Dryden test pilot Rogers Smith as co-pilot.

Birk commented at a post-flight briefing, "The flight was better than predicted. The airplane handled better than the simulator had shown."

The AFTI F-111 research aircraft was modified with a wing that can change its camber (fore and aft wing curvature) and its wing sweep to adjust to varied flight conditions.

The variable camber capability of the aircraft is expected to allow optimum efficiency at supersonic, transonic and subsonic speeds by adopting the best wing shape for each speed regime. The research program will demonstrate the use of smooth, variable camber technology for improved aircraft payload and range capability, better maneuverability, greater fuel efficiency, and improved aircraft handling qualities over current aircraft wing lift-altering devices.



Fully developed, the system would lead to an aircraft equipped with an automatic flight control system with several modes of control. Cruise Camber Control mode

would optimize the trailing-edge flap position for maximum cruise speed, Maneuver Camber Control mode would continuously position leading- and trailing-edges for optimum lift-to-drag ratio depending on the lift coefficient and speed of the aircraft. Maneuver Enhancement/Gust Alleviation mode would enhance the aircraft response to pilot control imputs while at the same time reducing the aircraft's sensitivity to wind gusts.

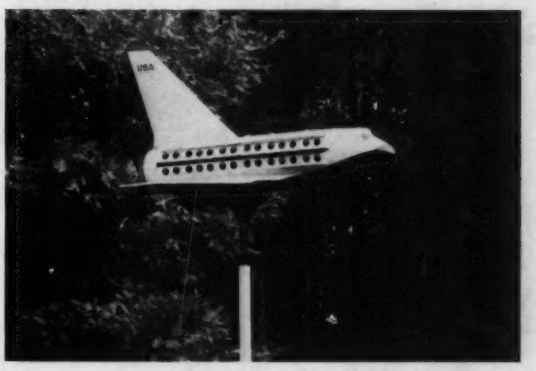
The AFTI F-111 is designed for research rather than to serve as a production prototype. The F-111 testbed was selected, in part, because its variable-sweep wing allows simulation of different types of military aircraft and it has the performance to fly as subsonic, transonic and supersonic speeds necessary to demonstrate the MAW system in various scenarios.

The AFTI F-111 research is a joint program of the NASA Ames-Dryden flight Research Facility and the U.S. Air Force's Flight Dynamics Laboratory. Additional support is provided by the Air Force Flight Test Center. The Boeing Military Airplane Company is the manufacturer of the aircraft.

NASA's ATS-3 communications satellite provided critical communications support for the international rescue and relief efforts of the American Red Cross and the Pan American World Health Organization during Mexico City's devastating earthquake in September.

The satellite, developed 18 years ago by NASA's Office of Space Science and Applications, Washington, D.C., was the main communication link with the outside world when the earthquake disrupted all other forms of communications.

A resident of Catlett, Va. designed and built a bird house measuring 8 ft by 4 ft in the form of the Space Shuttle. The structure has the capability of housing over 50 birds and took 2 years to build.



A Delaware Water Pollution Control Group recently visited NSTL in hopes of using NASA technology to solve many of the environmental problems in the state.

The Delaware study group was one of many groups turning to ongoing NSTL research to learn to optimally use natural biological processes to remedy environmental problems caused by population growth and industrialization. The particular problem the state of Delaware is addressing is updating septic tanks and other waste water treatment systems to keep from polluting the Chesapeake Bay which is so productive in seafood and important to the East Coast.

However, by using natural biological processes these wastes can possibly be treated and stabilized to the point that the water can be emptied in a relatively pure form back into the Chesapeake Bay.

NASA's Outstanding Handicapped Federal Employee of the Year Award was presented to Gerry R. Higgins of the systems Analysis and Integration Laboratory in the Science and Engineering Directorate, Marshall Space Flight Center. Higgins was nominated by the Shuttle Projects Office for his exceptional contributions in the computer sciences field.

On November 18-20, 1985, NASA's 1985-87 Presidential Management Interns (PMI) toured the Langley Research Center during their Orientation Seminar, held at the Fort Magruder Conference Center, Williamsburg, VA. The PMI Program is a formalized management training program for men and women who demonstrate strong leadership abilities and have obtained advanced degrees in public or business administration. The NASA program develops potential executives in many areas: management, budget and program analysis and international and public affairs. From left to right. (first row, kneeling) David Kurtz, Hdq./SBR, Gregory Davison, Hdq./EPR, Beth Caplan, JSC/BK, William Marshall, Hdq./L, (second row) Janet Rowlands, JSC/BW, Richard Arbuthnot JSC/AH, Amy Kennedy JSC/AH, Karen Poniatowski, Hdq./MRF. (third row) Steven Cook, Hdq./SPB and J. Scott Spell, KSC/AC.

Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans — and at a tiny percentage of the tax dollar. Here is an example:

Insulation Material

Manufactured by Hitco Materials Division of Armco, Inc., Gardena, California, a ceramic fiber insulation material known as Refrasil has been used extensively as a heat-absorbing ablative reinforcement for such space systems as rocket motor nozzles, combustion chambers and re-entry shields. In the Space Shuttle, for example, it is used to cover rocket nozzles and it lines the walls of the main fuel tank to keep temperatures within proper limits. Refrasil fibers are highly porous and do not melt or vaporize until temperatures exceed 3100 degrees Fahrenheit. Due to these and other properties, Refrasil has found utility in a number of industrial high temperature applications where glass, asbestos and other materials fail.

An example is a problem-solving project wherein NASA's Aerospace Research Application Center (ARAC), a component of the Indianapolis Center for Advanced Research, provided assistance to a manufacturer of hard rubber and plastic molded battery cases. Richardson Battery Parts Division of Witco Chemical Corporation, located in Indianapolis, asked ARAC's help on a problem related to heavy steam-heated molds employed in the manufacture of battery cases. Richardson wanted to reduce the heat loss from the sides of the molds to curb the high energy costs of generating steam and to increase worker safety in handling the molds. A Richardson engineer calculated that up to 95 percent of the input heat into the molds was being wasted in radiation to the outside of the molds. Due to clearance restrictions, Richardson needed an insulating material less than one-quarter inch thick to fit around the outside of the molds. The material had to withstand rough treatment during mold block changes and resist exposure to hot water, steam, hydraulic fluids and mold temperatures that average 390 degrees Fahrenheit. Richardson tried applying conventional materials but found none suitable.

ARAC conducted a search of 11 data bases, identified more than 100 pertinent reports and followed up by discussing the problem with officials at three NASA centers. ARAC's analysis report to Richardson Division listed several materials that seemed to meet company requirements. Richardson studied the options and selected one-eighth thick Refrasil ceramic fiber cloth as best suited.

Some 500 — about 80 percent — of the company's molds are now fitted with Refrasil insulation, which is wrapped around the mold and tightened by easily installed and readily removable steel bands. In the upper photo, the material is shown closeup. Steam usage for molding at Richardson Division has been reduced by 20 percent due to Refrasil application, and the initial cost of installation was paid back in only 35 days. The company now plans to insulate the steam lines leading to the molds with Refrasil cloth.

* NASA does not endorse commercial products developed as a result of its Technology Utilization or Patent Licensing Programs, but it does encourage the widest possible use of its technology.

*U.S. GOVERNMENT PRINTING OFFICE: 1986-491-575:20005